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The Effect of Variety and Depth of Sowing on Depth of Secondary Root Zone in Oats

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The Effect of Variety and Depth of Sowing on Depth of Secondary Root Zone in Oats[1]

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Abstract. Secondary roots are generally initiated approximately 2 cm below the soil surface regardless of whether the seeds are sown at that depth or deeper. In one experiment, conducted in the greenhouse in January, the seedlings established secondary roots between 1 and 2 cm below the soil surface, even when the seeds were planted 7.5 cm deep. In an identically conducted experiment in April, the zone of secondary root initiation was directly related to depth of planting with some being as deep as 4.6 cm. The environmental factors which were variable between the 2 experiments were photoperiod and temperature. All 5 oat varieties produced the same root depth patterns.

Cereal grain plants produce two and sometimes three classes of roots: (a) seminal or seed roots which develop from the lower end of the germinating seed; (b) secondary roots initiated from the nodes immediately above the subcoleoptilar internode; and (c) aerial or brace roots which develop from stem nodes above the ground. Genotype and environment determine whether the aerial roots develop. According to Martin and Leonard (1) and Weaver *et al.* (2, 3, 4) the secondary root system of cereal grains are established approximately 1 inch below the soil surface even when the seeds are sown deeper.

Small grain plants tend to lean when heavy rains cause the top soil layer (1 to 2 inches) in the fields to be "soupy". Morphological features of small grains which may contribute to leaning are the secondary root attachment zone serving as a fulcrum and the stem and the internode between the secondary and primary root systems serving as lever on opposite sides of the fulcrum. Under this hypothesis the subcoleoptilar internode could reduce leaning if it were longer and/or had a better primary root anchorage. It is conceivable that both the genotype and depth of planting may affect the length of the subcoleoptilar internode.

Depth of planting should have an effect on subcoleoptilar internode length if the secondary root system initiation is always 1 inch below the soil surface (1, 2, 3, 4). The paper reports the effects of oat varieties and species and depth of planting upon subcoleoptilar internode length and the depth of secondary root establishment.

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Materials and Methods

The materials used were the diploid strain, Saia; the tetraploid strain, P.I. 193958; and 3 hexaploid varieties, A465[3], Clintland, and Craigs-afterlea. Two identical experiments were conducted by sowing seeds of these varieties in the greenhouse in flats containing a soil mixture of loam, peat, and sand in the ratio of 2:1:1. To insure equal seedling size and growth rate, seeds of uniform size were used within each variety. The experimental design was a split plot with 3 replicates and whole and subplots consisted of oat varieties and depths of planting, respectively. Each subplot consisted of 20 seeds planted in a row across a flat and 4 rows were sown per flat. The depths of planting were 1.0, 2.5, 5.0, and 7.5 cm below the soil surface. The two experiments were grown in January (experiment I) and April (experiment II) of 1960.

Four weeks after the seedlings emerged, the tops were cut at the soil surface and roots were separated from the soil. The depth from the soil surface to the secondary root zone and the length of the subcoleoptilar internode were measured on each seedling.

Differences among treatments and varieties means were tested for significance by an analysis of variance.

Results and Discussion

The depth of initiation of secondary roots was related to the depth at which the oat seeds were sown (Table 1 and Figure 1). In experiment I the depths of secondary root initiation were 1.0 to 2.0 cm, whereas in experiment II the secondary roots of the tetraploid and hexaploid varieties were initiated as deep as 4 cm when the seeds were sown 7.5 cm deep. The results from experiment I were similar to other reported data, but the data from the second experiment conflict with published reports

Table 1. Pertinent mean squares from the analysis of variance on data from the depth of secondary root nitiation of oat seedlings for 5 varieties planted 1.0, 2.5, 5.0, and 7.5 cm deep.

Variation due to	Degrees of freedom	Mean square
Varieties	4	.83
Varieties x experiments	4	.70
Error (a)	16	.55
Depths	3	24.10*
Depths x varieties	12	.36*
Depths x experiments	3	5.79*
Error (b)	60	.10

*Significant at the 1% level.

[3] A465 is a drought-resistant oat strain received from Mr. W. Hartley of Australia.

(1, 2, 3, 4). The differential reaction in the two experiments may be related to the differing environmental conditions when the experiments were conducted. Experiment I was conducted in January when the natural photoperiod was short and greenhouse temperatures were maintained at 70° F. In April, when experiment II was grown, the natural photoperiod was 13 to 14 hours and the daytime temperatures often went above 70° F due to the intense sunlight.

The varieties did not differ significantly in depth of secondary root initiation. Although 5 varieties of oats represent a small sampling of oat germplasm, these varieties were chosen to repre-

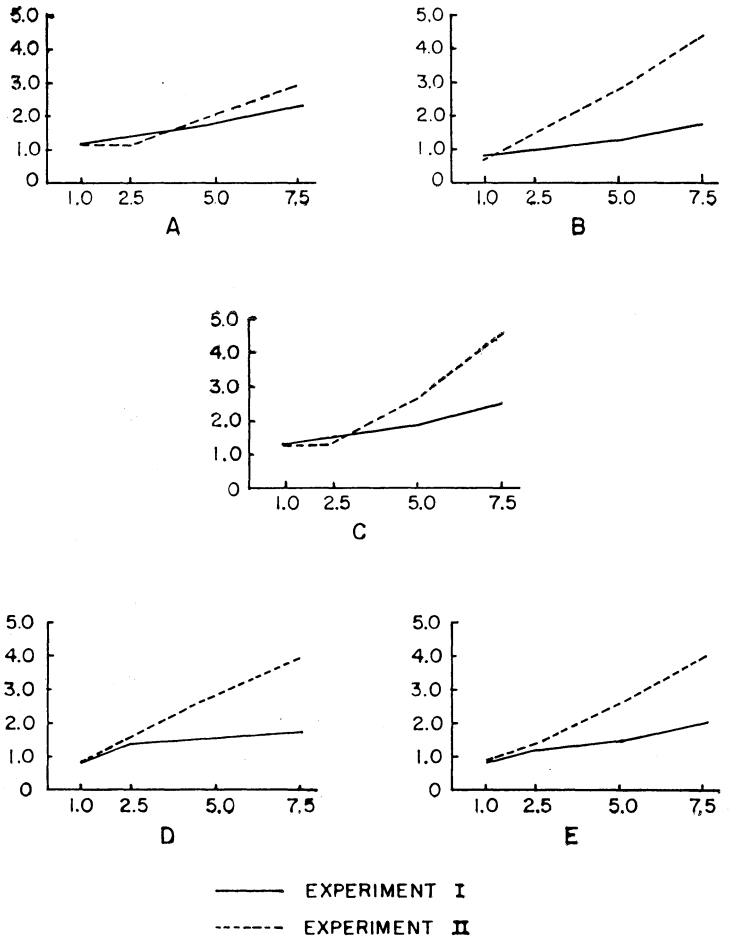

Figure 1. The depth of initiation of the secondary roots of oats seedlings sown at 4 different depths: A, Saia; B, P. I. 193958; C, A465; D, Clintland; E, Craigsafterlea. The abscissa represents the depth of secondary root initiation (cm) and the ordinate the depth of planting (cm).

sent diverse types. This suggests that oat varieties do not differ in depth of secondary root initiation.

The mean length of the subcoleoptilar internodes for the 5 oat varieties sown shows a reciprocal relationship to the depth of secondary root initiation (Figure 2). In experiment I, most of the differences in depth of planting were reflected in the subcoleoptilar internode length since the secondary roots were

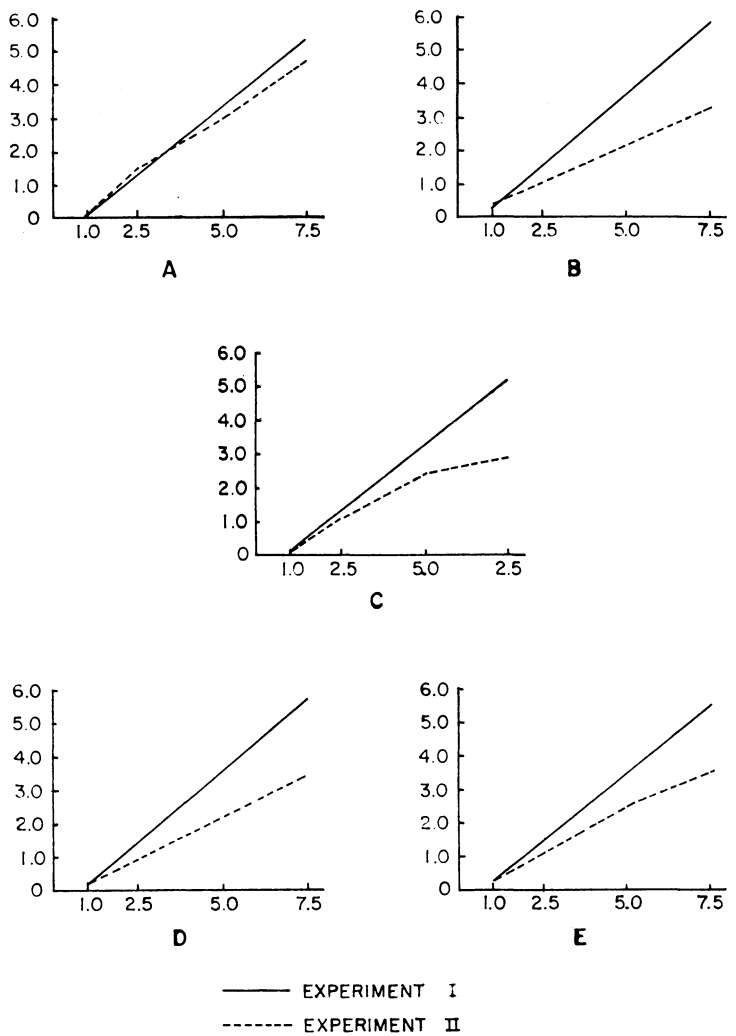

Figure 2. Mean length of subcoleoptilar internode for 5 oats varieties planted at 4 different depths: A, Saia; B, P. I. 193958; C, A465; D, Clintland; E, Craigs-afterlea. The abscissa represents the internode length (cm) and the ordinate the depth of planting (cm).

initiated at 2 cm or less below the soil surface. However, in experiment II the differences in depth of planting were reflected both in the internode length and secondary root depth. All varieties, with the possible excepton of Saia, reacted similarly.

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